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PRIVATE SHORT-TERM INTERNATIONAL CAPITAL FLOWS

by

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A THESIS

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled Private Short-Term International Capital Flows submitted by Leonard Landry in partial fulfilment of the requirements for the degree of Master of Arts

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Abstract

Canada is again operating under a flexible exchange rate system as it did in the fifties. This results in increased interest in the operation of policy tools under the flexible rate system. How can capital flows and in particular short-term capital flows be used to improve the Canadian economy? How will short-term capital flows hinder attempts to improve the economy? To answer these questions short-term capital flows must be understood. This paper attempts to present a simple model of short-term capital flows which provides for estimates of policy effects. The hypothesis presented is that short-term capital flows result from the actions of interest arbitragers, speculators and traders who perform both functions. The capital flow then depends on the interest differential between countries, the forward and spot exchange rates and the degree of trade encouragement. In addition to presenting a model of total short-term capital flows the components of the short-term flows are also examined.

Highly reliable estimates of the model coefficients did not result largely due to over simplification of the real world situation. It was possible to conclude that speculative-arbitrage was fairly exstensive in the period examined and that there may be some truth in the parity

psychology hypothesis. The examination of the components of short-term capital flows did not prove very rewarding.

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Chapter 1

Introduction

Under a flexible exchange-rate system, private short-term international capital flows are highly influential in affecting exchange rate adjustments. Capital flows also have a significant effect on the domestic money supply and thereby greatly affect the central government's monetary policy. Understanding the causes and determinants of capital flows would be advantageous in controlling the capital flow or employing it to meet our needs. In this paper we shall investigate short-term international capital flows, their determinants and component parts. A quarterly model of short-term capital flows will be presented, tested and compared to other works on the subject.

There are numerous works on international short-term capital flows some of which will be discussed later in this paper. Most have been formulated in a manner not allowing for estimates of the effects of policy changes or not aiming at explaining the complete flow. For example, they may only wish to explain speculative flows or interest arbitrage flows. Larger existing models of the external sector of the Canadian economy are not suitable for our purposes either since the short-term capital flow is usually left as a

residual explained by the other accounts of the balance of payments.[1]

Recently Richard Caves and Grant Reuber published a study on the external sector of the Canadian economy for the flexible exchange rate period 1951 to 1962.[2] The work includes a model of the short-term capital market. Owing to the importance of the work as Canada is once again under a flexible exchange rate system, the Caves-Reuber work cannot be passed by without comment. The validity of several points which Caves and Reuber make are in doubt in the author's opinion, for example, their inclusion of the merchandise balance as a determinant of the short-term capital inflow, their conclusion that Wonnacott's "parity psychology" hypothesis[3] cannot be proven, and the strength of their sensitivity estimates.

There is still room and need for work on a short-term

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[1] For example see: John F. Helliwell, et al., The Structure of RDX2, Bank of Canada Staff Research Studies, (Ottawa: Publications Committee of the Bank of Canada, 1971), p.127 or Nanda K. Choudhry, et al., TRACE, An Annual Econometric Model of the Canadian Economy, Working Paper Series No.6908, (Toronto: University of Toronto Press), p.91.

[2] Richard E. Caves and Grant L. Reuber, Capital Transfers and Economic Policy: Canada, 1951-1962, Harvard Economic Studies, Vol. CXXXV, (Cambridge, Mass.: Harvard University Press, 1971).

[3] Paul Wonnacott, The Canadian Dollar 1948-1962 (Toronto: University of Toronto Press, 1965), p.178.

capital flow model. This paper attempts to develop a model explaining the capital flow for reasons of interest arbitrage, trade credit and exchange rate speculation. Chapter 2 sets out the theory and estimates the model. Chapter 3 compares the model developed in this paper with those of other works. Chapter 4 draws the results of our own work and that of others together forming several conclusions.

Chapter 2

The Basic Model

This chapter sets out a model simulating the behavior of interest arbitragers and exchange rate speculators in supplying short-term foreign funds or exchange to the Canadian market. In a later chapter we will then be able to estimate the results of policy decisions on capital flows.

Normally in estimating a supply function it is not necessary to be concerned with the demand function. Unfortunately, in this case the normal procedure cannot be followed. The available data can not be used as the dependent variable in a supply equation. The data is the flow which has taken place and therefore is determined by both supply and demand. An exchange market model will have to be briefly reviewed. An exchange market model consists of three equations, the demand for foreign exchange, the supply of foreign exchange, and the equilibrating condition that supply should equal demand.

The quantity of foreign exchange required is the net total of three items, the balance on current account, the balance on long-term capital account, and official reserve changes. The first two can be combined to form the basic

balance which is a function of the spot exchange rate. The third item, official reserve changes, arises under a flexible exchange rate only if the authorities wish to influence the rate. They may buy foreign exchange when the Canadian dollar is high in order to lower its value and sell foreign exchange when the Canadian dollar is low in order to raise the Canadian dollar's value. It is clear that one of the determinants of the demand for foreign exchange is its price.[1]

The supply of foreign exchange is dependent on exchange rates and interest rates. The quantity of foreign exchange supplied is the short-term capital inflow. Since the short-term capital flow is numerically both the amount of foreign exchange supplied and demanded, the equilibrating condition is fulfilled. But, because the short-term capital flow data is the equilibrium flow, the actual supply equation cannot be estimated. However, in what follows the flow data is treated as if it were the supply data since the determinants of supply and demand and therefore the flow are very similar. Further, the procedure is justified if it can be assumed that it is the amount of foreign exchange interest arbitragers and speculators desire to supply which is the

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[1] Jerome L. Stein, "International Short-Term Capital Movements", The American Economic Review, LV (March, 1965), 48.

limiting factor and therefore determines the flow. It must be remembered that in either case the setting up of the model is simplified but that the results will actually be an estimate of the flow and not the supply equation.

The supply of short-term foreign exchange arises from the actions of interest - arbitragers and foreign exchange speculators. Each type of action will now be discussed separately; then the individual areas will be combined to form the complete model.

To begin setting up the model, interest arbitrage actions are reviewed as a determinant of short-term capital flows. Spraos[2], and Black[3] in his footsteps, have taken interest arbitrage to be the only determinant of short-term capital flows. Spraos defines three types of interest arbitrage which account in some manner for all types of short-term capital flows. The first type is "pure-interest arbitrage" the sole purpose of which is to take advantage of the net interest differential. The net interest differential results when present and future exchange rates are considered in addition to interest rates. If RF is the

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[2] J. Spraos, "Speculation, Arbitrage and Sterling", The Economic Journal, LXIX (March, 1959), 1.

[3] Stanley W. Black, "Theory and Policy Analysis of Short-Term Movements in the Balance of Payments", Yale Economic Essays, VIII (Spring, 1968), 5.

forward exchange rate and RS the spot exchange rate where the exchange rate is defined as the U.S. price of a Canadian dollar, and CS and USS are respectively the Canadian and U.S. short-term interest rates, then funds will flow to Canada from the U.S. if RF(1+CS/100)/RS is sufficiently greater than (1+USS/100). When the returns which can be earned on a U.S. dollar in Canada are greater than the returns on the U.S. dollar invested domestically, by an amount which exceeds the cost of covering against exchange rate adjustments and also sufficiently exceeds the costs of currency conversion, investment capital will flow from the U.S. to Canada.

The second type of interest arbitrage which Spraos defines is "trader-arbitrage". This type of arbitrager also has the exchange risk covered and therefore bases his decision on the same considerations as the pure-arbitrager. For example, a Canadian importer with a foreign exchange commitment can obtain trade credit, paying the foreign countries interest rate while buying foreign exchange forward guarding against a devaluation of the Canadian dollar. His alternative is to borrow domestically, pay the domestic interest, use the borrowed funds to buy foreign exchange spot and pay for his imports. The "trade-arbitragers" actions have the same outcome as that of a pure arbitrager. The "pure-arbitrager" transfers additional

supply of funds to the high net interest area while the "trade-arbitrager" transfers additional demand for funds to the low net interest area. The person supplying funds to the "trade-arbitrager", often the U.S. exporter, acts exactly as the "pure-arbitrager" does.

The third type of interest arbitrage is "speculator-arbitrage". It involves an uncovered transaction; an exchange risk is taken. "Speculator-arbitrage" may occur in the process of trade financing or as an independent investment decision.

An importer who has a future commitment in foreign exchange may maintain the position, pay the foreign interest, but speculate that the price of foreign exchange will fall sufficiently to make up the cost of the interest payments as well as lower the effective price of his imports. His alternative is to borrow domestically, buy foreign exchange, terminate his commitment and simultaneously sell foreign exchange forward.

An investor expecting a revaluation of a foreign currency may buy that country's currency spot and invest in the country at their interest rate. His alternative is to invest domestically while purchasing forward the foreign exchange which he expects to rise in value. The choice for the trader or investor is based on the same four variables

as for pure or trader arbitrage but also on the expected rate. In addition, the trader or investor must determine whether it is more profitable to speculate in the spot or forward market.

In a form similar to that previously used, an American speculator's decision is based on whether or not $(X/RS)(1+CS/100)RSE$ is greater or less than $X(1+USS/100)+(X/RF)RSE$ where X is the number of U.S. dollars invested and RSE is the exchange rate expected in the next period. If the first is greater the American speculator speculates in the spot market. The amount by which the speculator profits on speculating in the spot market is still given by the difference $RSE(1+CS/100)/RS-(1+USS/100)$. This value determines whether he speculates at all. If it is a positive value it will be profitable for him to speculate.

Spraos has defined all short-term flows as occurring for interest-arbitrage reasons. He has neglected short-term flows which occur purely to take advantage of exchange rate adjustments. For the speculative aspects of the flow we turn to Rhomberg.* Rhomberg has defined all short term capital flows as occurring for speculative reasons.

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* Rudolf Robert Rhomberg, "Fluctuating Exchange Rates In Canada: Short-Term Capital Movements and Domestic Stability" (unpublished Ph.D. dissertation, Yale University, 1959), p.92.

According to Rhomberg speculation on exchange rate movements may be divided into two categories. The first category is the adjustment in timing of trade and long term capital transactions which occurs because the exchange rate is not expected to remain at its present level. These adjustments are virtually impossible to measure since there is no indication of a transaction until it has occurred. When it would have occurred had exchange rate conditions not changed is not generally known.

The second type of speculation is observable. It is the adjustment in the short-term positions of those who hold foreign currency assets. Asset holders who expect the exchange rate to rise will buy Canadian currency, those expecting the exchange rate to fall will sell Canadian currency. These adjustments are recorded as short-term capital flows of the balance of payments.

Looking at how profits can be made from exchange rate speculation investments will facilitate the understanding of the second type of speculation. The American speculator first converts his currency into Canadian dollars. For simplicity assume his initial investment is one U.S. dollar. He then invests it at the relevant rate for one period, say ninety days. At the end of the period he will have (1+CS/100)/RS Canadian dollars. He expects that he will be

able to convert this into U.S. currency at a certain rate RSE so that he will have RSE(1+CS/100)/RS American dollars. He must compare this with what he would have if he had not speculated but had invested in his own country. This is (1+USS/100) American dollars. He then bases the decision to invest in Canada on whether RSE(1+CS/100)/RS-(1+USS/100) is positive. What this in effect is, is uncovered interest arbitrage which may take place because of the interest differential, or because of a combination of the interest differential and expected exchange rate adjustment (speculative arbitrage). If the flow occurs exclusively due to the expected exchange rate adjustment, the formulation of the decision variable may be simplified to (RSE/RS)-1. This shall be refered to as the "pure speculation" variable.

The theoretical models proposed by Spraos and Rhomberg may now be combined. The short-term capital flows which have been outlined in this section are: pure and trader arbitrage, the decision variable being RF(1+CS/100)/RS-(1+USS/100); speculative arbitrage, the decision variable being RSE(1+CS/100)/RS-(1+USS/100); and pure speculation, the variable being (RSE/RS)-1. For simplicity and to facilitate comparison with other works, the independent variables have been rewritten before being put consecutively into the model presented below.

$$STK=C^0 + C^1(NID) - C^2\{RS-RSE(\underline{1+CS/100}) \} - C^3(RS-RSE)+U$$

where:

NID= the net interest differential, $RF - RS\frac{(1+USS/100)}{(1+CS/100)}$

Clearly one of the main problems in a test of this model will be multicollinearity. To reduce multicollinearity the speculative arbitrage variable is removed assuming that the "pure arbitrage" and "pure speculative" variables will pick up the actions of the asset holders who consider both exchange rate adjustments and the interest rate differential.[5] In this case the model to be tested is

$$STK = C^0 + C^1(NID) - C^2(RS-RSE) + U^0$$

Short-term capital flows depend on the net interest rate differential and the difference between the present spot exchange rate and the spot exchange rate expected to occur in the next period.

Expectations Proposals applied to the Short-Term Capital Flow Model

To be able to test the model's ability to explain short-term international capital flows, the time series data

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[5] Richard E. Caves and Grant L. Reuber, have argued similarly for covered and uncovered interest arbitrage; Capital Transfers and Economic Policy: Canada, 1951-1962, Harvard Economic Studies, Vol. CXXXV, (Cambridge, Mass.: Harvard University Press, 1971), p. 80.

for the expected exchange rate, RSE, must be obtained. No such series exists, at present nor may it be possible to obtain an accurate series for the expected exchange rate. The series must be approximated.

The following section of this chapter is an attempt to develop an approximation for the expected exchange rate. Ten proposals are presented and substituted into our short-term capital flow model. The ability of these ten proposals to aid in explaining short-term capital flows is then tested.

In any attempt to simulate the formation of expectations, the simulation model should contain every factor which would influence the holder of the expectation. This is of course impossible. The ten following proposals are an attempt to ascertain some consistent pattern on some variable which presumably would figure prominently in the formation of a speculator's exchange rate expectations. For policy analysis purposes it would also be very beneficial if the variable chosen were a policy variable and therefore allowed a better estimate of the effects of policy changes. Policy variables figure prominently in expectations and should therefore be included in any estimate of expectations.

1.) The simplest proposal for the formulation of

expectations is that used by Caves and Reuber[6], Powrie[7], and the Bank of Canada's RDX1[8]. All propose that exchange rate expectations are inelastic and therefore change to a lesser extent than a change in the actual rate. Speculators always expect the previous period's rate will be closer to the future rate than is the present exchange rate. Speculators will then move into Canadian dollar assets if the exchange rate falls. They anticipate a return to a higher exchange rate at which time they may reconvert to U.S. dollars at a profit.

There are a couple of problems with this proposal. First speculators' expectations may not be completely inelastic, or inelastic enough to be visible. They may not expect the previous rate to be re-established within one period or the reversal of the exchange rate to be immediate even if they do expect it to happen. Second, theoretically, stability of the exchange rate may not be possible if speculators first reject a new exchange rate as not being permanent but in the following period they accept the very same rate as permanent.

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[6] Ibid. 75.

[7] T.L. Powrie, "Short-Term Capital Movements and The Flexible Canadian Exchange Rate, 1953-1961", Canadian Journal of Economics and Political Science, XXX (February, 1964), 79.

[8] John F. Helliwell, et al. The Structure of RDX1, Bank of Canada Staff Research Studies, (Ottawa: Publications Committee of the Bank of Canada, 1969), p. 25.

In spite of these problems, we shall test the proposal's ability tc simulate spectators' exchange rate expectations. Substitutien cf the prcposal into the model yields

$STK=C^{01} + C^{11}NID - C^{21}CRS + U^{1}$

where CRS = RS - RSI1 with Li indicating the number of periods a variable is lagged.

The superscripts on the coefficients in this and the following equaticns can be used tc identify the proposal. The first numeral cf the superscript distinguishes the coefficients within an equation. The second numeral refers to the proposal with its specific assumptions. The second numeral takes values frcm 1 to 10 since there are ten proposals.

2.) The forward exchange rate may be a very useful proxy for exchange rate expectaticns.[9] The fcrward rate is determined by the demand for fcrward ccver by trade hedgers and interest arbitragers and the supply of forward exchange due to speculators.

As pointed cut earlier in this paper, interest arbitrage is profitable if

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[9] Rhomberg, p 115.

RF(1+CS/100)/RS-(1+USS/100) is greater than zero. For further interest arbitrage not to take place the difference must be zero.[10] Rearranging terms yields RF=RS(1+USS/100)/(1+CS/100) If speculators believe the exchange rate will rise they will push the forward rate to a level in excess of what interest arbitrage would have it set at, RF will be greater than RS(1+USS/100)/(1+CS/100). In this case the rate which speculators expect will occur in the next period is indicated by adding the present exchange rate to the speculation caused increase in the forward rate. The expected rate is

RF-RS(1+USS/100)/(1+CS/100)+RS.

Substituting this into the capital flow model results in the following:

$$STK = C^{02} + C^{121}NID - C^{22}\{RS - RF + RS\left(\frac{1+USS/100}{1+CS/100}\right) - RS\} + U^2$$

which reduces to

$$STK = C^{02} + C^{121}NID - C^{22}\{-RF + RS\left(\frac{1+USS/100}{1+CS/100}\right)\} + U^2$$

Recall that NID = RF - RS (1+USS/100)/(1+CS/100) so that our second independent variable is simply -NID. The model in its simplest form can be written:

$$STK = C^{02} + C^{12}\ NID + U^2$$

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[10] S.C. Tsiang, "The Theory of Forward Exchange and Effects of Government Intervention on the Forward Exchange Market", International Monetary Fund Staff Papers, VII (April, 1959), pp. 79-80.

where

$$C^{12} = C^{121} + C^{22}.$$

3.) Arndt has proposed that "current expectations are adjusted by a proportion of the deviation of the actual current rate from the previous expected normal rate."[11] In equation form:

$$RSE-RSEL1 = (1-a)(RS - RSEL1)$$

where $0 \leq a \leq 1$[12], and L1 indicates that RSE is lagged one period. This can be solved for the expected rate:

$$RSE = (1-a)(RS+aRSL1+a^2RSL2+a^3RSL3+...)$$

The expected future spot rate is a function of past exchange rates decreasing in importance over time.

Arndt's formulation still does not allow for present changes which have as yet not been felt in the exchange market. Also, application of this proposal to the model forces the employment of the Koyck transfer and therefore the problems associated with this method.[13] The model may be written

$$STK = C^{03} + C^{13}NID-aC^{23}CRS -aC^{13}NIDL1 + aSTKL1+U^3$$

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[11] Sven W. Arndt, "International Short Term Capital Movements: A Distributed Lag Model of Speculation In Foreign Exchange", Econometrica, XXXVI (January, 1968), 60.

[12] Ibid., p.61.

[13] L.M. Koyck, Distributed Lags and Investment Analysis (Amsterdam: North-Holland Publishing Co., 1954).

4.) The next proposal for estimating exchange rate expectations is by Kesselman.[14] In a paper on the Canadian flexible exchange rate period he proposed three formulations, an extrapolative model, a regressive model and a combination of the two which shall be tested here.

The extrapolative model proposes that the expected future rate is the present spot rate plus some constant fraction of the change in the rate over the past period. In equation form:

$$RSE = RS + K (RS - RS(-1))$$

where for stability K is less than one and by assumption K is greater than zero. As Kesselman points out though, "Given an exogenous shock in the exchange rate, extrapolative behavior can explain only a movement away from the normal exchange value...It cannot explain a return to the normal value without a new exogenous change acting in that direction."[15]

The regressive model is to overcome this problem. The regressive expectations model in equation form is

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[14] Jonathan Kesselman, "The Role of Speculation in Forward-Rate Determination: The Canadian Flexible Dollar 1953-1960", The Canadian Journal of Economics, IV (August, 1971), 281.

[15] Ibid.

$$RSE = RS + M(RSE - RS), \quad M>0.$$

The model assumes RSB is the normal rate and expectations are adjusted according to the deviation of the spot rate from it. The expected rate is above the present rate if the normal rate is above the present rate, and below the present rate if the normal rate is below the present rate.

As the extrapolative model can explain only a movement away from the normal exchange value, the regressive model can explain only a movement towards the normal rate. Neither will be correct in all cases so that we have elected to test only the third formulation.

Kesselman's third formulation is referred to as the "dual mechanistic model" and is the previous two models combined.

It can be written:

$$RSE = RS + K(RS - RSL1) + M(RSE - RS), \quad 0<K<1, \ 0<M$$

As yet we have not specified the variable RSB, the normal rate. We shall use three alternate values for this variable; the constant one, in order to bring in the "parity psychology" hypothesis, Powrie's four quarter centered moving average, (P),[16] and a simple average, (RSA), composed of the future period's exchange rate, the present exchange

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[16] Powrie, p 81.

rate and the exchange rate of the last two quarters. The three alternatives substituted into Kesselmans dual mechanistic model and then into the model of short-term capital flows are written consecutively as:

a) $STK = C^{04} + C^{14} NID + C^{24} K(CRS) + C^{24} M(1-RS) + U^4$

b) $STK = C^{05} + C^{15} NID + C^{25} K(CRS) + C^{25} M(P-RS) + U^5$

c) $STK = C^{06} + C^{16} NID + C^{26} K(CRS) + C^{26} M(RSA-RS) + U^6$

where:

$P = \{(RSL2 + RSL1 + RS + RS1)/4 + (RSL1 + RS + RS1 + RS2)/4\}/2$

and $RSA = (RS1 + RS + RSL1 + RSL2)/4$

5.) Speculators may expect the exchange rate to move towards the normal exchange rate. Thus, the normal exchange rate may be a useful proxy for the expected rate. RSE becomes RSB. We may test the three alternative values for RSB; the parity psychology, the four quarter centered moving average, and RSA.

The "parity psychology" and the four quarter centered moving average have already been tested, the former by Caves and Reuber,[17] the latter by Powrie,[18] but each failed to yield results which would indicate that they approximate the expected exchange rate. Because the data has been improved

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[17] Caves and Reuber, pp.83-84.
[18] Powrie, p.81.

since these tests were made and because our model is slightly different from those in which the variables were originally tested,[19] we have chosen to retest these formulations. The models are presented below.

$$STK = C^{07} + C^{17}NID - C^{27}(RS - 1) + U^{7}$$

$$STK = C^{08} + C^{18}NID - C^{28}(RS - P) + U^{8}$$

$$STK = C^{09} + C^{19}NID - C^{29}(RS - RSA) + U^{9}$$

6.) Our last proposal for an expectations model is again from the work by Powrie. The proposal is that speculators are able or nearly able to correctly forecast the next period's exchange rate. The expected value of the exchange rate is the spot exchange rate of the next period. Again he did not obtain a significant coefficient but for the same reasons as given earlier we shall retest the proposal. The model is formulated as

$$STK = C^{010} + C^{110}NID - C^{210}(RS - RS1) + U^{10}$$

At the end of the previous section it was mentioned that due to multicollinearity the speculative arbitrage variable would be excluded from the model. It is assumed that this exclusion will not lower the explanatory power of the model since the pure arbitrage and pure speculative

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[19] Our model does not contain the variable BMTUS as the Caves Reuber model does. Powrie tests a model with only (RS-P) as the independent variable.

variables will also pick up capital flows due to speculative arbitrage. It would be useful though to be able to test the extent to which speculation or arbitrage is of the pure or mixed type. To enable the performance of this test the capital-flow model with the ten alternate expectation proposals is set out but where the only independent variable is speculative arbitrage. As the first set of models will pick up both pure and mixed forms of speculation and arbitrage this set will only pick up the mixed form, speculative arbitrage.

The models are set out below in the same order as the pure arbitrage - pure speculation models with the superscripts having the same meaning. Since these are different models the coefficients of course do not have the same values.

$STK = C^0 - C^1 (RS - RSE(N)) + V^0$

$N = (1+CS/100)/(1+USS/100)$

1) $STK = C^{01} - C^{11} CRS(N) + V^1$

2) $STK = C^{02} - C^{12}(-NID(N) + RS - RS(N)) + V^2$

3) $STK = C^{03} - C^{13}(RS - RS(N)) + aC^{13}(RS(N) - RSL1) + aSTKL1 + V^3$

4) a) $STK = C^{04} - C^{14}(RS - RS(N)) + C^{14}K(CRS)(N) + C^{14}M(1 - RS)(N) + V^4$

   b) $STK = C^{05} - C^{15}(RS - RS(N)) + C^{15}K(CRS)(N) + C^{15}M(P - RS)(N) + V^5$

   c) $STK = C^{06} - C^{16}(RS - RS(N)) + C^{16}k(CRS)(N) + C^{16}M(RSA - RS)(N) + V^6$

5) a) $STK = C^{07} - C^{17}(RS - N) + V^7$

b) $STK=C^{08}-C^{18}(RS-F(N))+V^{8}$

c) $STK=C^{09}-C^{19}(RS-RSA(N))+V^{9}$

6) $STK=C^{010}-C^{110}(RS-RS1(N))+V^{10}$

Tests Performed, Methods and Results

In the previous section of this chapter two sets of models for short-term international capital flows were set out.

The first set hypothesizes that short-term capital flows can be explained solely by pure arbitrage and pure speculation variables with speculative arbitrage being picked up by the two pure form variables. The set of models results from inserting ten exchange rate expectation proposals. The main form of the set of models is written:

$STK = C^{0}+C^{1}(NID)-C^{2}(RS-RSE)+U^{0}$

The second set of models uses only a speculative-arbitrage variable to explain the capital flows. This set of models is presented in order to test the extent to which capital flows result from combined arbitrage and exchange rate considerations. The same ten exchange rate expectation proposals have been inserted as in the pure form model. In its basic form the speculative arbitrage model can be written

$STK = C^{0}-C^{1}(RS-RSE(N))+V^{0}$

In this section of the chapter the expected exchange rate proposal which best allows the speculative activity variable to explain capital flows will be established. This will be done for both the pure arbitrage - pure speculation model and for the speculative - arbitrage model. After establishing the proposal within each set of models which best explains the capital flow the two models will be compared. From comparison of the two models the type of activity which takes place in the short-term capital market may be determined.

Before proceeding with the results of these tests there is an alteration to the pure arbitrage - pure speculation model which will simplify the estimation of policy effects. In the pure arbitrage - pure speculation model the variable NID, defined to be RF-RS(1+USS/100)/(1+CS/100), is used to pick up pure interest arbitrage. If NID is positive it is advantageous to invest in Canada since the rate of return is greater in Canada than in the U.S. even after allowing for the cost of covering against exchange rate adjustments. It is hypothesized that capital will flow from the U.S. to Canada in order to take advantage of the higher Canadian returns. Because the cost of forward cover is so closely entangled with the variable NID and with interest rates, it will be difficult to determine the exclusive effects of a

change in interest rate policy. For this reason it would be beneficial to divide the variable NID into an interest rate differential variable and a cost of forward cover variable.

The division of NID can be made if the interest differential DS is defined as CS-USS and the cost of forward cover CFC is defined as the percentage discount on the Canadian dollar, CFC = 100(RS-RF)/RS. Multiplying NID by (1+CS/100)/RS yields RF(1+CS/100)/RS - (1+USS/100). This is the pure arbitrage decision variable discussed in the first section of this chapter. Arranging terms and substituting 1-CFC/100 for RF/RS yields

CS/100-USS/100-CFC/100-(CFC/100)(CS/100).

The term (CFC/100)(CS/100) would usually be very small so that it may not affect interest arbitragers decisions. If the term is assumed to be zero the interest arbitrage decision variable may be written as (DS-CFC)/100.

In summary, if (CFC/100)(CS/100) is so small that it does not affect interest arbitragers then we may divide NID into the variables DS/100 and CFC/100.

To test the assumption that (CFC/100)(CS/100) is insignificant, SIK was regressed on a constant and NID using quarterly data from the period commencing the first quarter of 1952 and ending the second quarter of 1961.

The results were

STK=91.62 + 47484.41 NID
(5.48) (6.71)

$\bar{R}^2$=54

D.W.=1.55

F =44.95

When STK was regressed on (DS-CFC)/100 using the same data, the results were not significantly altered.

STK=91.06 + 48685 (DS-CFC)/100
(5.49) (6.76)

$\bar{R}^2$=55

D.W.=1.56

F =45.63

The conclusion is that the affect of (CFC/100)(CS/100) on interest arbitragers appears to be negligible.

The next step is to completely simplify the calculation of the effects of interest rates by separating (DS-CFC)/100 into DS/100 and CFC/100. Again a regression was performed to test the alterations.

The results of this test were

STK=61.38 + 597.05 DS-383.72 CFC
(3.04) (7.21) (4.73)

$\bar{R}^2$=60

D.W.=1.65

F =28.35

Dividing the variable (DS-CFC) into two variables improves the square of the coefficient of correlation corrected for degrees of freedom. The "F" statistic is lowered since the increased number of variables outweighs the increase in the explanatory power. However, the "F" statistic still indicates that the capital flows are significantly explained by the model.

From the above tests it seems apparent that by using the short-term interest rate differential and the cost of forward cover instead of the combined variable NID, pure interest arbitrage will still be picked up but, now the affects of interest rate changes on short-term capital flows are easily estimated. For this reason the two separate variables DS and CFC will be substituted for the variable NID in the pure arbitrage-pure speculation model. By doing this a degree of freedom is lost but there are a sufficient number of observations to keep the degrees of freedom still workable. The pure arbitrage - pure speculation model is now written

$$STK=C^0+C^1(DS)-C^2CFC-C^3(RS-RSE)+U^0$$

The speculative - arbitrage model remains as

$$STK=C^0-C^1(RS-RSE(N))+V^0$$

The results of the ten exchange rate expectation proposals applied to the two models may now be discussed.

The models were tested using quarterly data for the period from the first quarter of 1952 to the second quarter of 1961. The results of the pure arbitrage - pure speculation models appear in Table Ia. The results of the speculative - arbitrage models appear in Table Ib.

In both model forms the Kesselman proposal with the normal rate taken as parity (proposal 4) was best able to explain the capital flows. The pure arbitrage - pure speculation model results were

$$STK = \underset{(3.47)}{80.86} + \underset{(7.73)}{569.85}\,DS - \underset{(3.44)}{262.94}\,CFC - \underset{(3.38)}{3167.92}\,CRS + \underset{(1.77)}{1506.26}\,(1-RS)$$

$$\bar{R}^2 = .71$$

$$D.W. = 1.42$$

$$F = 23.51$$

The corresponding speculative - arbitrage model results were

$$STK = \underset{(2.26)}{57.80} - \underset{(6.12)}{48091.42}\,(RS - RS(N)) - \underset{(3.87)}{4019.46}\,CRS(N) + \underset{(2.70)}{2499.24}\,(1-RS)(N)$$

$$\bar{R}^2 = .62$$

$$D.W. = 1.17$$

$$F = 20.92$$

The signs are as expected except for that of CRS in the pure arbitrage - pure speculation model. In the formulation of the model with Kesselman's proposal (number 4 of the ten proposals substituted into the pure arbitrage - pure

Table Ia

Short Term International Capital Flows; Pure Arbitrage-Pure Speculation Models

Model	1	2	3	4	5	6	7	8	9	10
C	53.16 (2.99)	91.62 (5.48)	42.23 (1.97)	80.86 (3.47)	50.76 (2.68)	50.46 (2.64)	92.94 (3.53)	55.78 (3.00)	52.39 (2.77)	64.16 (3.03)
NID		47,404.41 (6.71)								
DS	541.74 (7.30)		548.48 (4.67)	569.85 (7.73)	501.97 (6.40)	522.06 (6.39)	626.90 (7.64)	491.05 (6.26)	506.89 (6.39)	600.27 (6.98)
CFC	-307.54 (4.14)		-195.90 (1.62)	-262.94 (3.44)	-280.82 (3.68)	-279.18 (3.49)	-328.77 (3.89)	-298.68 (3.97)	-278.46 (3.50)	-394.67 (4.66)
CRS	-3,300.14 (3.43)		-4,105.80 (3.47)	-3,167.92 (3.38)	-1,735.99 X	-1,667.02 X				
DSL1			-138.32 X							
CFCL1			-43.23 X							
STKL1			.21 (1.42)							
(1-RS)				1,506.26 (1.77)			1,736.80 (1.79)			
(P-RS)					5,205.84 (2.01)			7,189.51 (3.58)		
(RSA-RS)						3,977.69 X			6,154.17 (3.40)	
(RS-RS1)										-7ue.77 X
$\bar{R}^2$	69	54	68	71	68	67	62	67	68	58
D.W.	1.42	1.55	1.71	1.42	1.37	1.31	1.55	1.44	1.40	1.52
F	28.62	44.95	13.68	23.51	18.70	19.12	21.15	24.10	25.50	17.86

X indicates the coefficient is not significantly different from zero at the 90% confidence level

Table Ib

Short Term International Capital Flows, Speculative-Arbitrage Models

Model	1	2	3	4	5	6	7	8	9	10
c	25.91 (1.60)	44.27 (3.45)	-2.84 x	57.80 (2.26)	1.75 x	1.09 x	67.21 (1.64)	19.76 (1.33)	-25.20 (1.69)	19.69 x
NCRS	-5,671.73 (4.28)									
(-NID(N)+RS-RS(N))		-29,963.33 (7.42)								
RS-RS(N)			-37,590.91 (4.31)	-48,091.12 (6.12)	-37,318.07 (4.52)	-38,691.60 (4.65)				
RS(N)-RSL1			-5,443.90 (4.61)							
STYL1			.30 (2.58)							
CPS(N)				-4,019.46 (3.87)	-2,776.24 (1.65)	-1,591.02 x				
(1-RS)(N)				2,499.24 (2.70)						
(P-RS)(N)					5,921.76 (1.94)					
(RSA-RS)(N)						6,726.77 (1.88)				
RS-N							1,724.12 x			
RS-P(N)								11,907.61 (5.05)		
RS-RSA(N)									-10,892.37 (5.27)	
RS-RSI(N)										-1,772.00 x
$\bar{R}^2$	32	59	60	62	54	56	.01	42	43	-.03
DW	.99	1.58	1.48	1.77	1.08	1.02	.86	1.03	1.02	.83
F	18.29	55.07	18.93	20.92	14.51	15.83	x	25.51	27.80	x

speculation model) we see that the coefficient of CRS is expected to be positive yet, we have obtained a negative coefficient. In Kesselman's model, if the exchange rate rises, it was assumed that expectations would be revalued upwards. The coefficient K was assumed to be positive. But a positive K may indicate destabilizing speculation. If a rise in the exchange rate is expected to be maintained speculators will ensure the rise through their attempts to convert to Canadian currency increasing the demand for and price of the Canadian dollar. A negative value for K may indicate stabilizing speculation. A negative K indicates that a rise in the exchange rate will cause a fall in exchange rate expectations. Speculators expect the trend to reverse itself and therefore adjust their expectations in the opposite direction to the recent increase. They then would convert Canadian currency into U.S. currency to take advantage of the present high rate which they expect to fall. By doing this they exert a downward pressure on the exchange rate preventing it from rising further.

Since in the model estimated coefficient of CRS, $C^{24}K$, is estimated to be negative while the coefficient of (1-RS), $C^{24}M$, is as expected, C^{24} is assumed positive as expected while K is assumed negative. The results tend to indicate that speculation was stabilizing in the period tested.

The tests add some weight to the parity psychology hypothesis. In the Kesselman formulation with the normal rate taken as parity the coefficient of (1-RS) was found to be significant at the 95% confidence level. Unfortunately an "F" test is not able to show that the variable (1-RS) significantly adds to the model.

Comparing the two model forms, the pure speculation - pure arbitrage and the speculative - arbitrage form, it is found that the former is only slightly more able to explain short-term capital flows. This may indicate that a great majority of short-term international capital flows occur because of combined exchange rate and interest rate considerations.

International Short-Term Capital Flow Components.

Having established a model for total international short-term capital flows, it may be of some use to do the same for the capital movements which form the total

series.[23] The classification of the components of short-term flows which will be used is basically the one provided by Statistics Canada in The Canadian Balance of International Payments: A Compendium of Statistics 1946-1965.[24] The initial classification will be into three categories; "Net trade in outstanding securities", (NTOS), "Canadian dollar holdings of foreigners", (CDHF), and "Other capital movements", (CTHER).

Although trade in outstanding securities is not considered a short-term flow by Statistics Canada, there is some contention that it should be. Caves and Reuber find a greater improvement in their results when NTOS is included with the short-term series than when it is included with the portfolio series.[25] Further, they find NTOS better explained by short-term flow determinants than by portfolio flow

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[23] Although it may be argued that the correct way to begin our study would have been to explain variations in the component flows, we chose to begin with the total flow for several reasons. It is the total flow which is of primary importance. Only when specific policies which discriminate between components are considered are the component models important. Still, substitution between components must be known to determine the end result. Beginning with the component flows might also have resulted in numerous independent variables which may prove insignificant to the total flow. The advantages of beginning with the total flow are clarity and simplicity.

[24] Dominion Bureau of Statistics, The Canadian Balance of International Payments: A Compendium of Statistics 1946-1965 (Ottawa: Queen's Printer, 1967) p.31.

[25] Caves and Reuber, p.73.

determinants. Arndt points out that we may classify flows into short or long-term by either considering "date to maturity of the traded asset or the motivation underlying the transaction".[26] Since we are considering speculative flows, the motive criteria is important. It is possible that a person will purchase a foreign security which is approaching its redemption date in order to take advantage of an expected exchange rate adjustment.

Fowrie has also included NTCS in his short-term capital flow series but found that when NTOS alone was regressed on the independent variables none proved to be significant. A test is required to clarify the situation.

The second category "Changes in Canadian dollar holdings of foreigners" consists of; the change in foreigner's holdings of deposits in Canada, (CDHFD), the change in foreigners holdings of Government of Canada demand liabilities, (CDHFG), and the change in foreigners holdings of Canadian treasury bills, (CDHFT). This category clearly consists of components which we would expect to be highly responsive to our independent variables. All are very low risk investments in themselves.

The last category, "other capital movements", consists

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[26] Arndt, p.62.

of; American dollar holdings of Canadians in the form of deposits, (AUHCD),[27] Canadian commercial and finance company paper and obligations, (CANPA), and all other transactions, (OTHERK). The last component, OTHERK is important but troublesome in that it contains "changes in loans and accounts receivable and payable and also a balancing item representing differences between direct measurements of current and capital accounts."[28] Changes in accounts receivable and payable are important in determining trader arbitrage and speculation but the analysis of any results is hampered by the fact that the size of the measurement errors is not known. Therefore the extent the regression results are due to the measurement errors cannot be known.

The three categories and the components were tested for response to pure interest arbitrage, pure speculation with the ten expectation proposals, and speculative arbitrage. The best results of these tests are presented in Table IIa and Table IIb.

The results tend to indicate that only the uncovered interest differential significantly explains NIOS. Arndt's

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[27] This item is referred to as "Bank balances and other short-term funds abroad excluding official reserves" by Statistics Canada.

[28] Dominion Bureau of Statistics, The Canadian Balance of International Payments: A Compendium of Statistics 1946-1965

Table IIa

Components of Short Term International Capital Flows; Pure Arbitrage - Pure Speculation Models

Dependent Variable	STK	NTOS	NTOS	NTOS	OTHER	ADHCD	OTHERK
C	80.86 (3.47)	12.50 (2.53)	13.09 (1.09)	16.74 (2.32)	59.76 (2.52)	26.40 x	25.58 (1.31)
DS	569.85 (7.73)	88.73 (3.19)	8.88 x		445.07 (6.14)	117.42 (1.75)	268.49 (3.26)
CFC	-262.94 (3.44)		44.83 x		-169.37 (2.25)	-45.32 x	-113.31 (1.43)
CRS	-3,167.92 (3.38)		-479.71 x		-3,290.49 (3.57)	-1,593.92 (1.87)	
(1-RS)	1,506.26 (1.77)				1,853.15 (2.21)	1,670.37 (2.15)	
DSL1			69.37 (1.52)	72.25 (2.30)			
CFCL1			-73.82 (1.62)	-44.42 (1.61)			
NTOSL1			.39 (2.34)	.40 (2.51)			
(RS-P)							-5,020.29 (2.38)
R^2	71	20	37	34	64	22	36
DW	1.42	1.30	1.81	1.88	1.67	2.07	1.95
F	23.51	x	3.78	7.04	17.32	3.64	7.24

Table IIb

Components of Short Term International Capital Flows; Speculative - Arbitrage Models

Dependent Variable	STK	NTOS	OTHER	ADHCD	OTHERK
C	57.80 (2.26)	7.04 (1.37)	42.95 (1.05)	22.40 x	16.16 (1.30)
RS-RS(N)	-48,091.12 (6.12)	-5,719.30 (1.92)	-38,613.34 (5.41)	-10,175.56 (1.64)	
CRS(N)	-4,019.46 (3.87)		-3,844.18 (4.08)	-1,742.53 (2.13)	
(1-RS)(N)	2,499.24 (2.70)		2,494.94 (2.97)	1,839.89 (2.53)	
RS(N)-RSL1		-360.60 x			
NTOSL1		.45 (2.70)			
RS-P(N)					-7,415.30 (3.76)
R^2	62	30	60	24	28
DW	1.17	1.81	1.62	2.04	1.74
F	20.92	6.25	19.12	4.79	14.16

distributed lag proposal was best able to explain NTOS but DS, CFC and CRS were not significant. An F test revealed that although DSL1, CFCL1 and NTOSL1 are significant they are not able to add significantly to the explanation of the dependent variable. We have either not used the correct expectation formulation or trade in outstanding securities is not responsive to exchange rate adjustments. Since the uncovered interest differential is significant while CFC is not, DS may have picked up uncovered interest arbitrage which is partly speculative. We should therefore not conclude that NTOS is unresponsive to exchange rate adjustments.

The category CDHF which was expected to yield highly significant results proved a great disappointment. None of the models used proved able to significantly explain any portion of the flow. This is consistent with Powrie's results as he finds CDHF not to contribute to the relationship of STK with the independent variables.

The components of CDHF were regressed on the independent variables even though CDHF did not yield any significant results. Regressing the components ensures that it was not simply aggregation that caused the insignificant results. For all three components the models were not able to explain a significant portion of the variation in the

dependent variable. It may be fairly safely concluded that no such relationship exists to the extent that it must be considered further.

The final category, other capital movements, provided the best results. Kesselman's proposal, with the normal rate taken as one, again proved best able to explain the variation in the dependent variable. An "F" test showed that at the 95% level of confidence the variable (1-RS) does add to the explanatory power of the model.

Since the category OTHER yielded the best results of the three categories the subdivisions of OTHER were expected to yield significant results also. Kesselman's formulation, with the normal rate taken as parity, yields the best fit for the component ADHOT. An "F" test also showed the variable (1-RS) significantly adds to the explanatory power of the model. Unfortunately CFC is not significant. It must be dropped from the model before the pure form model can be considered as explaining the dependent variable better than the speculative-arbitrage model. The close results of the two model forms may indicate that very little pure arbitrage or pure speculation takes place and that it is mainly speculative arbitrage which causes the capital flow.

The component CANPA did not prove to be significantly explained by any of the models. The component OTHERK yielded

only slightly better results with only the variable DS consistently having a coefficient significantly different from zero. The expectations formulation which seemed to yield the best results was the four quarter centered moving average, P. An "F" test also revealed that the variable (RS-P) was a significant addition to the model.

An important result of the tests on CTHERK is that the constant term is positive and significantly different from zero at the 90% significance level for a one tailed test. The constant term can be interpretted as the average short-term capital flow which occurred over the period for reasons other than interest arbitrage or exchange rate speculation. Recall that CTHERK is the change in loans and accounts payable and receivable or in other words trade credit. The three reasons for exporters extending trade credit are for interest arbitrage profits, exchange rate speculation profits, and sales encouragement. The effect of the first two reasons is picked up by the interest arbitrage and speculation variables. The constant term of the regression estimates the average net trade credit flow for the purpose of enhancing sales.

The constant term estimates the average flow to Canada for trade financing as approximately 25.5 million dollars per quarter. The balance of merchandise trade with the U.S.

(Canadian imports in excess of Canadian exports) averaged $170.2 million per quarter over the period. Therefore, approximately 15% of Canada's imports in excess of exports with the U.S. would still have been financed by U.S. exporters even if there would have been no advantage in doing so other than to facilitate sales.

The conclusion is greatly weakened since the flow OTHERK is not completely explained. Some relevant variables may have been excluded making the constant term biased.[29] In addition the series OTHERK includes not only accounts payable and receivable, but also measurement errors of the balance of payments. If the measurement errors make up a large fraction of the subdivision OTHERK, then the conclusion is unfounded.

Summary

The tests in this chapter indicate that short-term capital flows may largely occur for speculative - arbitrage reasons but that pure arbitrage and pure speculation also play a role in capital flows. Kesselman's dual mechanistic model with the normal rate as parity and K negative was best able to simulate exchange rate expectations.

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[29] Jan Kmenta, Elements of Econometrics (New York: Macmillan Company, 1971), p.394.

The resulting model was

STK=80.86+569.85 DS-262.94 CFC-3167.92 CRS+1506.26 (1-RS)

No improvement in the model resulted from dividing the short-term capital flow into its components.

Chapter 3

Comparison With Other Models

This chapter will compare the results of the last chapter with those of other models. To begin with the Caves-Reuber[1] model which is very similar to the one just presented will be outlined and the results compared with the model of Chapter 2. Other empirical studies of short term international capital flows which will be discussed are those by Rhomberg[2], Black[3], Arndt[4], Officer[5],

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[1] Richard E. Caves and Grant L. Reuber, Capital Transfers and Economic Policy : Canada , 1951-1962 , Harvard Economic Studies, Vol. CXXXV (Cambridge, Mass,: Harvard University Press, 1971), pp 70-87.

[2] Rudolf Robert Rhomberg, Fluctuating Exchange rates in Canada: Short-Term Capital Movements and Domestic Stability (unpublished Ph.D. dissertation, Yale University, 1959), pp.108-119.

[3] Stanley W. Black, "Theory and Policy Analysis of Short-Term Movements in the Balance of Payments", Yale Economic Essays, VIII (Spring, 1968), 5-47.

[4] Sven W. Arndt, "International Short Term Capital Movements: A Distributed Lag Model of Speculation in Foreign Exchange", Econometrica, XXXVI (January, 1968), 59-70.

[5] Lawrence H. Officer, An Econometric Model of Canada Under the Fluctuating Exchange Rate, Harvard Economic Studies, CXXX (Cambridge, Mass.: Harvard University Press, 1968), 81-83.

Powrie[6], and the Bank of Canada's RDX1.[7]

The Caves-Reuber Model

The Caves-Reuber model of international short-term capital flows is but a part of a much larger work on capital transfers. As they state, "The primary concern of this study is to measure the responsiveness of capital movements to changes in domestic policy instruments and to ascertain the effects of these policy-induced or endogenous capital flows upon the ability of domestic policies to influence income..."[8] Caves and Reuber have therefore attempted to formulate their model in a fashion which allows for simple comprehensive estimates of the effects of policy.

The dependent variable of the Caves-Reuber model is quarterly short-term capital flows of the Canadian balance of international payments plus quarterly net trade in outstanding securities.

The series is both the amount of spot foreign exchange

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[6] Tom L. Powrie, "Short-Term Capital Movements and the Flexible Canadian Exchange Rate, 1953-1961", Canadian Journal of Economics and Political Science, XXX (February, 1964), 76-94.

[7] John F. Helliwell, et al., The Structure of RDX1, Bank of Canada Staff Research Studies, (Ottawa: Publications Committee of the Bank of Canada, 1969), p.23.

[8] Caves and Reuber, 72.

demanded in every quarter and with the existing exchange rates, interest rates and other relevant variables, the amount supplied. The series is the flow of foreign exchange. It is the determinats of this flow that Caves and Reuber are interested in. Caves and Reuber have tested five variables as determinants of short-term capital flows. The determinants are; the "balance of merchandise trade with the United States, the Canadian-U.S. short-term interest-rate differential, an expectations variable involving the forward excharge rate, and an expectations variable involving the spot exchange rate."[9]

The first of Caves and Reuber's capital flow determinant variables, BMTUS (the balance on merchandise trade with the U.S.), is hypothesized to explain part of the short-term capital flow due to the nature of institutional payments practises. For example, U.S. exporters finance, through credit arrangement, some of their exports to Canada. An increase in American exports to Canada will result in an increase in trade credit financing and therefore in an increased flow of short-term capital to Canada in the form

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[9] Caves and Reuber, 73.

of credit.[10]

The second determinant of short-term capital flows, the interest differential, is important because it indicates the advantage of financing imports by either obtaining trade credit abroad or borrowing domestically. It is also relevant in American firms' decisions regarding the holding of cash balances either domestically or in Canada. In addition, interest arbitrage flows are partly determined by the interest rate differential, with exchange rates also being considered.

Because of the exchange rate consideration in interest arbitrage flows and because of trade hedging Caves and Reuber have included the forward exchange rate in the model. The spot exchange rate is the price of a Canadian dollar in terms of U.S. dollars. The forward exchange rate is the price in U.S. dollars at which speculators, interest arbitragers, and traders contract to trade Canadian currency in the next period. The two exchange rates are brought into the Caves-Reuber model in the form of the forward premium.

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[10] Caves and Reuber define BMTUS as Canadian imports minus Canadian exports. This definition is not consistent with their discussion in the text. According to their definition the coefficient of BMTUS should be positive since as Canadian imports rise BMTUS becomes more positive while capital inflows also increase. For BMTUS to have a negative coefficient it should be defined as Canadian exports minus Canadian imports.

The forward premium reflects the net demand for forward cover by trade hedgers and interest arbitragers and the "supply of forward cover determined by speculators' expectations about the movement of future spot rates."[11] Interest arbitragers find "a hedged investment in Canadian-dollar assets more attractive, given the short-term interest-rate differential, as the forward premium rises...Thus the net short-term capital inflow should be positively related to the forward premium..."[12]

The existence of exchange rate speculators requires the inclusion of an exchange rate expectations variable. In formulating the exchange rate expectations variable Caves and Reuber have used the argument that speculators base their judgments about future exchange rates on the relation between current and recent past values of the exchange rate. More specifically, if exchange rate expectations are inelastic a change in the rate will cause a smaller change in the expected rate. Speculators will act in a manner which will reverse the present change. They will buy foreign exchange when the exchange rate rises since they do not expect the rate to remain changed as extensively as it now is. Their actions serve to push the rate down again

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[11] Caves and Reuber, 77.
[12] Ibid.

fulfilling their expectaticns. The short-term capital flow will be negatively related to the quarterly change in the exchange rate if expectations are inelastic. However, the estimate of the extent cf capital flcw reaction to the rate change will be lower than in actuality since by fulfilling their cwn expectations speculatcrs reduce the reason for the capital flcw and therefcre reduce the capital flcw.

The model ccefficients were estimated using the ordinary least squares methcd which yielded:[13]

$$STK = 602\ DS + 31449\ FP - .4734\ BMTUS - 3512\ CRS$$
$$(7.82)\quad (4.30)\quad (3.63)\quad (3.61)$$

$\bar{R}^2 = .72$
$F(4,33) = 25.85$
D.W.=2.64
SEE=$68.5 million

where

STK=total net inflow cf short-term capital to Canada in millions of dcllars

DS=differential between Canadian and United States tender rate on three-month government Treasury bills where the tender rate is in percent per quarter (DS=CS-USS)[14]

FP=forward premium cn the Canadian Dollar in Dollars per quarter (FP=RF-RS)[15]

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[13] Ibid., 78.
[14] Ibid., p. XVI.
[15] Ibid.

BMTUS=Canada's exports to the United States minus her imports from the United States, in constant dollars[16]

CRS=quarterly change in the spot exchange rate. The spot exchange rate is the number of U.S. dollars per Canadian dollar, (CRS=RS-RSL1), (RS=$U.S./Can$)[17]

The period used in estimating the model extended from the first quarter of 1952 to the second quarter of 1961 inclusive, during which time the mean value of STK was calculated to be $52.2 million quarterly.[18]

Several variations of the basic model were also tested by Caves and Reuber. These included revising the forward premium into the percentage forward discount on the Canadian dollar (CFC), revising the interest rate differential, into a proxy for the covered interest differential and adding other interest and expectation variables. It was concluded that the initial model still resulted in the best fit. [19]

The following model does not alter the initial model

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[16] This definition is the reverse of that given by Caves and Reuber (p.xv). See footnote 10 earlier in this paper for explanation.

[17] Caves and Reuber, p. xv.

[18] Ibid., 78.

[19] Ibid., 82.

but is presented here for the sake of comparison with the results of Chapter 2.[20]

SIK= 600 DS - 325.5 CFC - .4740 BMTUS - 3522 CRS
(7.83) (4.32) (3.64) (3.63)

$\bar{R}^2$=.72
F(4,33)=25.96
D.W.=2.64
SEE=$68.4 million

Having set out the Caves-Reuber model it can now be compared to the model of Chapter 2. One of the main reasons for the difference in the estimated coefficients between the two models is that the data used by Caves and Reuber for the dependent variable has been corrected. The data for the dependent variable of the model in Chapter 2 is taken from the publication The Canadian Balance of Payments: A Compendium of Statistics from 1946-1965 (Ottawa: Queen's Printer, 1967). Caves and Reuber have taken their series from Officer and from the quarterly issues of the Canadian Balance of International Payments, of the period in question.

An important point to remember about both the Caves-Reuber model and the one estimated in Chapter 2 is that the data used for the dependent variable is a series of equilibrium points. The resulting models are not equations

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[20] Ibid., 79.

for the supply of short-term capital, but are estimates of the flow equation for short-term capital. Another reason the models should not be considered the correct estimate of the supply equation is because of the double direction of causation present in some of the variables.[21] For example, an increase in the interest rate differential will cause an increase in the capital inflow. The increase in the capital inflow in turn will lower the interest rate differential. The estimates are derived from figures which contain both these influences and therefore cannot be used to estimate one directional sensitivity. The coefficient of the variable CRS, the quarterly change in the exchange rate suffers under the same problem. An increase in the exchange rate causes a capital outflow if exchange rate expectations are inelastic. Speculators convert from Canadian to U.S. currency at the now more favorable rate in anticipation of earning a profit on reconversion to Canadian dollars when the rate returns towards its previous level. As they convert to U.S. currency they bid up the price of U.S. currency which means the exchange rate falls towards its previous level. Their actions help to fulfill their expectations. The regressions do not yield a direct estimate of the amount speculators would transfer between

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[21] Caves and Reuber, 85. Rhomberg, 119. Black, 42.

currencies due to exchange rate adjustments because the data used in the regressions resulted from two directional sensitivity.

In addition to the above mentioned problems under which the Caves-Reuber model and that of Chapter 2 suffers, the main drawback of the Caves-Reuber model is its confusion between a balance of payments approach and an exchange market approach.[22] The former method indicates the offsetting function of the short-term capital flow, the latter explains the flow. If we incorrectly interpret the offsetting function as explaining the flow we are in actuality saying demand explains supply.

In an exchange market model the net demand for foreign exchange results from merchandise and non-merchandise trade, long-term capital transactions, and official reserve fund actions. Caves and Reuber treat these items as exogenously determined. Next, due to the balance of payments identity, the sum of these items is equal but of opposite sign to that of the short-term capital flow. The short-term capital flow is the record of the net supply of foreign exchange brought forth to meet the demand. The aim of the model is to explain the variation in the supply. The confusion exists

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[22] Arndt, 68.

in that by including the variable BMTUS as an explanatory variable, Caves and Reuber are including an item which the capital supply offsets in the balance of payments but not an explanatory variable of supply. If they wish to explain the supply they must only include those variables which indicate interest arbitrage or exchange rate speculation.[23]

By regressing STK on interest arbitrage and speculation variables Caves and Reuber are able to pick up the trade credit flow resulting from arbitrage and speculation. Including BMTUS as a determinant of STK yields an estimate of the extent STK offsets BMTUS. But, the aim of the model was to explain why a short-term capital flow occurs and does offset the other balance of payments accounts, not to show the degree the short-term capital flow offsets the other accounts. A demand variable should not be used to explain supply. For these reasons BMTUS was not used as an explanatory variable in the model developed in Chapter 2. This will of course cause our coefficient estimates to differ form those of Caves and Reuber.

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[23] Other models which only use interest arbitrage and or, exchange rate speculation to explain the short-term capital flow are those by Rhomberg, Black, RDX1, Arndt, Officer, Powrie, Jerome L. Stein, "International Short-Term Capital Movements" American Economic Review, LV (March, 1965), 40-66. and, E. Ray Canterbery, "A Theory of Foreign Exchange Speculation under Alternative Systems", Journal of Political Economy, LXXIX (May/June, 1971), 407-436.

The point that remains to be investigated is why exporters finance their own exports. When exporters extend trade credit they are in effect acting as exporters and interest arbitragers[24] or speculators. Isolating the two actions will clarify this.

First, assume a Canadian imports goods from the U.S. Assume also that to pay for these goods he must borrow funds. Apart from exchange rate considerations (assume the exchange rate is fixed at parity) he will borrow where the cost is lowest. Assume the cost is lowest in the U.S. An American interest arbitrager, desiring to take advantage of higher rates of return in Canada will lend his capital to the Canadian importer. Canada receives the goods as well as a debt commitment. If the Canadian importer would have obtained the funds from the U.S. exporter through trade credit, nothing would have been altered. The U.S. exporter would have acted as an interest arbitrager.

The American exporter may also extend trade credit for speculative reasons. Assume the American exporter has sold goods agreeing on payment in Canadian currency. If he anticipates a rise in the exchange rate he may be willing to

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[24] J. Spraos, "Speculation, Arbitrage and Sterling". The Economic Journal, LXIX (March, 1959), 14.

extend credit. His alternative is to require immediate payment for the goods, then to hold the Canadian currency or invest it until the exchange rate alters. The argument may be clearer if the example of an expected fall in the exchange rate is used. If the exporter expects a fall in the rate and has agreed on payment in Canadian currency, he will not be willing to extend further credit or may attempt to draw in the existing credit he has extended.

We can establish three reasons why an exporter would extend trade credit: to take advantage of higher foreign interest rates (interest arbitrage profits), to accrue profits through exchange rate adjustments, (although the price of most U.S. exports are set in U.S. dollars) and to encourage or facilitate the sale of the product. By regressing the net of accounts payable and receivable on interest arbitrage and speculation variables an estimate of the flow due to the first two reasons may be obtained. It is difficult to put the third reason into variable form. If the net flow of accounts payable and receivable, is regressed on a constant as well as on the variables of the first two reasons, and the regression yields a good fit, the constant term is informative. The constant is that portion of the net flow which occurs for reasons other than trade credit profit. In this case it is the flow which occurs to facilitate sales. In other words if there were no profit to

be derived directly from extending trade credit, exporters would still extend that amount of credit shown by the constant term. It is this amount in comparison with EMTUS which can be considered direct trade financing.

The estimate derived by the above method is not directly comparable to that derived by Caves and Reuber. Our estimate is the average flow in each quarter over the period. The Caves and Reuber estimate is the increase in trade credit for an increase in the balance on merchandise trade. We will though, briefly list the two results.

Caves and Reuber's results indicate we can be 95% confident the interval from 22% to 72% contains the percentage of the change in the merchandise balance by which direct trade credit alters when the balance of merchandise trade changes. Results using the method outlined in this paper were not able to prove direct trade credit inflow to be different from zero at the 95% level of confidence. However, in Chapter 2 the average direct trade credit flow was shown to be greater than zero for a 90% confidence level. A 90% confidence region for the direct trade credit inflow of $25.5 million would be from approximately -$7.5 million to approximately $58.5 million. These figures can be converted to indicate that over the period American exporters' direct trade financing was between -4% and 34% of

the average value of the balance of merchandise trade. The negative sign is a result of the large standard error of our estimate and indicates that we can not rely on our results or draw very useful conclusions from them.

In addition to the above discussed exchange market-balance of payments approach difference of the model of Chapter 2 and the Caves-Reuber model, there is a slight difference in aim between the two models. Caves and Reuber wished to estimate interest rate and exchange rate sensitivity in a manner which facilitated simple calculations of the effects of policy. The aim of the model developed in Chapter 2 is to simulate as closely as possible, within technical limitations, the actual behavior of those who supply short-term capital. The differences become apparent in several areas.

The covered interest rate differential is the first area in which the different aims of the two works appear. Although Caves and Reuber are aware that interest arbitragers are interested in net changes in the interest differential and forward premium combined[25] they chose to maintain separate variables for the two under the assumption that not all interest arbitragers take covered positions.[26]

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[25] Caves and Reuber, 80.
[26] Ibid., 78

If Caves and Reuber's assumption is correct, combining the interest differential and forward premium variables will result in a loss of explanatory power. The interest differential and forward premium, maintained separately, will pick up both the actions of covered and uncovered interest arbitragers but the combined variable will only pick up the actions of covered interest arbitragers.[27]

In order to prove the correctness of their assumption Caves and Reuber compare the separate variables with what they refer to as the net interest differential. The net interest differential is defined as the interest differential minus the cost of forward cover (the percentage forward discount on the Canadian dollar).[28] They point out that this is only an approximation to the covered interest differential but that it is used since the actual covered differential does not allow for easy calculations of interest sensitivity.[29]

The last sentence above points out the crux of the matter. If the covered and uncovered interest differential are to be compared then the actual variables should be used especially since they are available. If approximations or

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[27] Ibid., 80
[28] Ibid.
[29] Ibid.

proxy variables are used we can not be as certain of our conclusions. The ease of interest sensitivity calculations should take second consideration in this instance.

The alternative is to prove the exact variables are not able to improve on the approximate variables. It is the alternative which was chosen in Chapter 2.

In Chapter 2 a brief test was performed which leads us to believe, in agreement with Tsiang[30], that the difference between the actual covered interest rate differential and the approximation is insignificant. Both the exact formulation, NID, and the approximation, DS-CFC, were tested yielding very similar results. It appears that the approximate variable is as able to capture interest arbitrage actions as is the exact variable.

Having concluded in Chapter 2 that the approximation of the covered interest differential provides the same results as the exact covered interest differential variable, the results of the covered interest differential test may be compared to the results of the uncovered interest differential test.

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[30] S. C. Tsiang, "The Theory of Forward Exchange and Effects of Government Intervention on the Forward Exchange Market", International Monetary Fund Staff Papers, VII (April, 1959), 80.

Caves and Reuber conclude from the comparison of their results that since the covered interest differential lowered the portion of the fluctuations in STK explained by the model, a substantial amount of uncovered interest arbitrage existed.[31] This is in contrast with Brecher who based his opinion on the Report of the Royal Commission on Banking and Finance, (Ottawa, 1964), pages 299 and 300 and concluded, "While no precise figure is available, it seems quite clear that interest-arbitrage transactions between Canada and other countries are generally carried out on a hedged basis."[32] However, the results of Chapter 2 favor Caves and Reuber's conclusion of extensive uncovered interest arbitrage.

In addition to the covered-uncovered variable comparison, we have also included a test on the variable RS-RSF(1+CS/100)/(1+USS/100) which is the uncovered interest differential with the expected exchange rate adjustment included. As discussed in the last chapter this variable only picks up speculative interest arbitrage. The full model picks up interest arbitrage, speculative interest arbitrage, and pure speculation. The speculative arbitrage

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[31] Caves and Reuber, 8C.

[32] Irving Brecher, Capital Flows Between Canada and the United States (n.p.: Canadian - American Committee, 1965), p.69.

model is able to explain nearly as much of the variation in short-term capital flows as is the full model. This indicates that uncovered interest arbitrage, i.e., speculative interest arbitrage, is fairly extensive. The results tend to agree with and reinforce those of Caves and Reuber on the extent of uncovered interest arbitrage.

Caves and Reuber's and our conclusion that uncovered interest arbitrage is fairly extensive must imply that speculation is fairly extensive. Several studies have reasoned that speculators react to the difference between the present exchange rate and the expected future exchange rate.[33] The problem is to derive speculators' expected future exchange rate. This is the second area which highlights the different aims of the two studies.

Owing to the numerous considerations taken into account by speculators, the formation of the speculators' expected rate is quite impossible. One must be content to attempt to derive some simple mathematical formulation based on a few of the most likely variables considered by speculators. Caves and Reuber have chosen a very simple but useful model which hypothesizes that the expected future rate is the last period's rate. With the Caves and Reuber variable, if it is

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[33] Rhomberg, 119., Arndt, 60., Stein, 48.

possible to obtain a significant coefficient for the variable CRS, (the difference between the present and expected rate where the expected rate is hypothesized to be the last periods rate), the effects of policy changes can be estimated. But, if a significant coefficient is not obtained we cannot conclude that speculators do not react to changes in the exchange rate. It may be that speculators do not simply assume the previous rate will recccur in the upcoming period, yet they dc expect the trend to reverse itself in the near future. Even if significant results are obtained it cannot be concluded that the past rate is the expected rate. The past rate may approximate the expected rate but a more complicated model may provide a closer approximation and therefore be better able to explain speculative flows.

It was in the hope of being better able to approximate and explain speculative flows that the last chapter included tests of alternative expectation proposals. The proposal which was found to be most able to explain fluctuations in STK due to speculation was, with a change of assumptions, Kesselman's "dual mechanistic model". It proposes that speculators adjust their expectations in the opposite direction to recent rate changes and also according as the rate is above or below parity. Unfortunately we were unable to derive an estimate of the proportion by which speculators

adjust their expectations.

The final point of divergence between the Caves-Reuber model and the model of Chapter 2 is the method of testing the "parity psychology" hypothesis. Caves and Reuber point out that the variable CRS, can be rewritten as the quarterly change in the deviation of the spot rate from parity.[34] But any other variable may be substituted for parity and the same results are maintained. They are quite correct in stating the test does not prove much.

In another test of the "parity psychology" hypothesis, Caves and Reuber substitute DRSP which is (RS-1), for CRS.[35] They find that they are unable to prove the coefficient of DRSP to be significantly different from zero. The reason they failed to obtain significant results for DRSP may have been because of the inclusion of the variable BMTUS. The variables DRSP and BMTUS are related. A rise in the exchange rate causes an increase in the variable DRSP. A rise in the exchange rate causes goods imported into Canada to fall in price and Canadian goods exported to the U.S. to rise in price in the U.S. BMTUS may therefore become more negative as Canadian imports increase and exports decrease. Multicollinearity may have occurred in the model causing the

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[34] Caves and Reuber, 77.
[35] Ibid., 84.

estimated variances of the coefficients to be biased upwards and therefore lowering the value of the "T" statistic.[36] Unfortunately tests for the relationship of BMTUS to (RS-1) were not able to reveal a strong relationship.

When STK was regressed on a constant, DS, CFC, and (RS-1) it was found that the coefficient of (RS-1) was significantly different from zero at the 90% confidence level. Unfortunately this cannot be interpreted as a proof of the parity psychology hypothesis. It is historically evident that the exchange rate has been near parity, substituting the constant "one" for the last period's exchange rate in the variable CRS to obtain DRSP may only be another test for inelastic expectations. The constant one just serves as a proxy for RSL1 which was near one in every quarter.[37] It was also noticed that the model in which DRSP is substituted for CRS yields a loser fit than do other models.

A test for the "parity psychology" may be better made by including it in the model which formulates the expected rate. Since short time periods and the immediate future are being dealt with it may not be correct to assume that

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[36] Jan Kmenta, Elements of Econometrics (New York: Macmillan Company, 1971), p. 388.

[37] I am grateful to Tom Powrie for pointing this out to me.

speculators expect the next periods rate to be parity although, they may expect in the long run for the rate to be very near parity. Kesselman's "dual mechanistic model" brings the parity hypothesis into the model in a way which does not require such a strong assumption as the variable DRSP alone does. Parity becomes only a part of the influence on the expectations of speculators. As pointed out in the last chapter the coefficients of Kesselmans proposal are significantly different from zero at the 95% level of confidence. This model is also best able to explain fluctuations in STK.

In summary there were two differences in the formulation and testing of the model developed in Chapter 2 and the Caves-Reuber model. First the model of Chapter 2 strictly employs the exchange market approach while Caves and Reuber combine both the exchange market and balance of payments approach. Second the aim of the model in Chapter 2 was to explain fluctuations in short-term capital flows while Caves and Reuber seconded this to their desire to maintain ease of calculation of policy effects. The different aims of the two models resulted in the model developed in Chapter 2 emphasizing the exact variables, the speculative variable and the parity psychology hypothesis.

Other Models.

As can be seen in Table III the previous chapter's model and the Caves-Reuber model have been better able to explain fluctuations in short-term capital flows than have other models. Each model must be looked at for the reasons this has occurred.

In the model which he tests by ordinary least squares, Rhomberg has used 3 independent variables; an indicator of exchange rate expectations (e), the quarterly change in the exchange rate (CR), and an interest rate differential variable (h). The variable "e", the indicator of exchange rate expectations,[38] is very similar to the variable (DS-CFC), the covered interest arbitrage approximation variable.

$$e = RF-RS-(USS/100 - CS/100) = RF-RS+DS/100$$
$$= DS/100-(RS-RF)$$

while

$$(DS-CFC) = DS-((RS-RF)/RS)\ 100.$$

Rhomberg finds the coefficient of the interest rate differential (in Rhomberg's notation DS is "-h") not to be significant. Rhomberg has included the interest differential due to its role in what we have called "speculative arbitrage". He separated the speculative

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[38] Rhomberg, 115.

TABLE III

Short Term Capital Flow Models

Model Author		Period	$\bar{R}^2$	D.W.	F
	STK = 80.86 + 569.85DS - 262.94CFC - 3167.92CRS + 1506.26(RS-1) (3.47) (7.73) (3.44) (3.38) (1.77)	1Q52-2Q61	71	1.42	23.51 (4,33)
CAVES-REUBER	STK = 6000S - 325.5CFC -3,522CRS -.4740 BMTUS (7.83) (4.32) (3.63) (3.64)	1Q52-2Q61	72	2.64	25.96 (4,33)
RHOMBERG	S = 74.8 - 110h - 39.1CR + 315e x (3.55) (3.25)	1Q52-4Q57	59		11.85 (3,20)
BLACK [a]	S = 95.8 + 554.9 (Xp-Y) (5.97)	1Q52-4Q63	52	2.05	51.98 (1,46)
ARIDT	STK = 64.05C - 33.84 CL1 + 34.01 (R-RL1) + .55 STKL1 (2.76) (1.51) (3.52) (4.23)	1Q52-4Q60	68	2.14	18.53 (4,30)
OFFICER	TBH = 16.0 + 2600RFD - 1000CRS + 29000MCRS - $1.3Q_1$ - $13.0Q_2$ - $14.0Q_3$	1Q51-1Q62	13	2.23	4.56 (6,41)
POWRIE	STK = 23.0 + 75.3 (C-A) + 60.3 (E-EL1) + 59.8 (C-A') + 15.9 (E-E1) + 2.7 (C-B) (2.43) (4.02) (2.69) x x'	1Q53-2Q61	57		9.67 (5,29)
RDX1	S = 10.54 + 102.2 (RO3-RTUS)+3144DRS-.9944DRSU+21705DRSF+152.2DSK2-96.26Q_3 (.23) (2.88) (1.35) (2.97) (1.75) (2.44) (2.48) -.2826 LTK (1.90)	1Q53-4Q65	38	1.72	5.51 (7,44)

a) Two Stage Least Squares

Variables defined overleaf

Table III continued

Variables

S • quarterly inflow to Canada of private short-term capital

h • U.S. short-term interest rate per quarter minus the Canadian short-term interest rate per quarter

CR • change in the exchange rate from the preceding quarter where the exchange rate is defined as the number of U.S. cents per Canadian dollar

e • indicator of exchange rate expectations = 90 day forward premium on Canadian dollar adjusted for the U.S. - Canadian interest differential in percent per quarter

X • quarterly average of noon quotations of the spot price of the U.S. dollar in terms of Canadian currency

Y • quarterly average of noon quotations of the ninety-day forward price of the U.S. dollar in terms of Canadian currency

p • (1 + RC/100)/(1 + RUS/100) where RC is the quarterly average of end-of-month quotations on the Canadian Treasury bill rate taken as a rate per quarter and RUS is the quarterly average of end-of-month quotations on the U.S. Treasury bill rate taken as a rate per quarter

C • the Canadian three months treasury bill rate minus the comparable U.S. rate

R • exchange rate defined as Canadian dollars per U.S. dollar

TBR • balance of transactions in Canadian treasury bills and U.S. treasury bills and certificates, in millions of dollars

RFD • forward exchange differential, number of U.S. dollars per Canadian dollar

WCRS • change in spot exchange rate if first quarter 1961 or beyond, 0 otherwise

C-A • difference between the average short-term interest rate in Canada and that in the U.S. in the quarter where interest rates are quarterly averages of average rates on weekly tenders for three-month treasury bills

E • average price of foreign currency in a quarter year

C-A' • Canadian-American short-term interest rate differential adjusted for the cost of forward cover

C-B • difference between Canadian and British three-month treasury bill rates

RO3 • average yield on short-term Government of Canada bonds, zero to three years

RTUS • market yield on U.S. Government three month bills

DRS • first difference of the Canadian price of U.S. dollars, in Canadian dollars per U.S. dollar

DRSU • DRS from third quarter 1961 to second quarter 1962, zero elsewhere

DRSF • DRS from third quarter 1962, zero elsewhere

DSX2 • dummy, equals 1 in each quarter of 1965, zero elsewhere

LTK • net long-term capital inflow in millions of 1957 dollars

arbitrage variable into pure speculation and pure arbitrage variables, obtaining the quarterly change in the exchange rate (CR) and the interest differential (h). His poor results for the interest differential in this case may indicate that for the shorter period over which he tested his model, speculative arbitrage tended to be determined mainly by the exchange rate speculation aspects and not by interest arbitrage considerations.

Another possible reason for the insignificant results of the coefficient of h in Rhomberg's tests is the relationship between the variables. He has included a speculative arbitrage variable (h and CR) and a pure interest arbitrage variable (e) in the same regression. This may result in multicollinearity since the speculative arbitrage variable contains some of the elements of the pure interest arbitrage variable.

Futher, Rhomberg's capital-flow series does not contain trade in outstanding long term securities. This may have caused the lower explained variation. In a larger model in which he uses the limited information maximum-likelihood method, Rhomberg is able to prove all his variables to be significantly different from zero.[39]

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[39] Rhomberg, pp.120-121.

Black's model is not as able to explain fluctuations in short-term capital flows as the model of Chapter 2 is since he uses only a covered interest arbitrage variable. He therefore is not able to pick up uncovered interest arbitrage or exchange rate speculation. Similar to Rhomberg, Black does not include trade in outstanding securities with the short-term capital flow series.

Arndt's lag formulation proposal for the expected exchange rate has the highest corrected R^2 outside of the model in Chapter 2 and that of the Caves-Reuber model. Arndt's model does not contain the forward exchange rate in any manner and therefore does not allow for covered-interest arbitrage. However, including the forward premium does not seem to increase the variation explained by Arndt's model. The Kesselman proposal was only very slightly better than Arndt's but due to the problems associated with the Koyck method we prefer the Kesselman proposal.

Officer does not attempt to explain the short-term capital flow. He states that in his model of the Canadian economy, "The only autonomous current endogenous short-term capital movement is the net inflow from transactions in Canadian treasury bills and United States treasury bills and

certificates."[40] This inflow is explained by the forward premium, quarterly change in the exchange rate and several dummy variables. His model is not very effective in explaining the flow but as Powrie found and our tests show, the variables Officer used are better able to explain the complete short-term capital flow series than the flow's components.

Powrie's model of short-term capital flows contains several variables which are similar to those of the model in Chapter 2. He has defined the exchange rate as the Canadian price of U.S. currency. The proper adjustments must be made before comparing the coefficients to those obtained in the last chapter which were derived with the exchange rate defined as the U.S. price of Canadian currency. Powrie has tested the proposal that speculators are able to predict future exchange rates by using the next period's exchange rate as a proxy for the expected rate. However, he is unable to prove the difference between this period's and next period's exchange rate to be a significant explanatory variable. It is interesting to note that if the future rate fails as a proxy for the expected rate then speculators are not accurate in predicting future rates. Their actions based on their expectations should not lead them to the

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[40] Officer, 81.

profits they had expected.

It cannot be concluded that since the coefficient of the difference between the present and next periods exchange rate is not significantly different from zero the variable is nct a determinant cf short-term capital flows. Multicollinearity may be present lowering the "T" statistic or sufficient variation to establish the relationship may not have occurred.

Powrie also includes the difference between Canadian and British short-term interest rates as an independent variable. Since both this variable and the expectations proposal just discussed are not significant the corrected R^2 is greatly lowered.

The Bank of Canada's model, RDX1, does not include trade in outstanding securities in the short-term capital flow series. The explanatory variables used are the interest rate differential, the quarterly change in the exchange rate, several variables for this change in specific periods, the long-term capital flow and several dummy variables. The addition of the dummy variables and the quarterly change in the exchange rate for specific periods may account for the lower corrected R^2. These variables do not increase the explanatory power of the model sufficiently to prevent the square of the multiple correlation

coefficient from falling when corrected for degrees of freedom. The RDX1 model does not include the forward exchange rate in any manner and therefore does not allow for covered interest arbitrage flows.

The model developed in Chapter 2 appears better able to explain short-term capital flows than other models for several reasons. The model has taken only an exchange market model approach and has expanded on the speculative aspects of the flow. Further, the model has covered the complete spectrum of determinants of short-term capital flows.

Chapter 4

Policy Effects

In Chapter 2 the theory behind a model of international short term capital flows was set out. The model was tested for its ability to explain the short-term capital flows of the fifties. In Chapter 3 the model and test results were compared with those of other recent works. This chapter sets out the information derived from the study, its limitations and problems, and areas in which further work should be done.

The model, estimated for the period extending from the first quarter of 1952 to the second quarter of 1961 was

$$STK = 80.86 + 569.85DS - 262.94CFC - 3167.92CRS + 1506.26(1-RS)$$
$$(3.47)\quad (7.73)\quad (3.44)\quad (3.38)\quad (1.77)$$

$\bar{R}^2 = .71$
D.W. = 1.42
F(4,33) = 23.51
SEE = $65.21 million.

Ordinary least squares estimation procedure was used. The actual mean of the dependent variable was $23.47 million while the calculated mean was $16.54 million.

All who have attempted empirical studies of the external sector of the Canadian economy have encountered the problem of simultaneously determined variables. This study was of course no exception. The problem is that a change in

one independent variable may directly or through the short-term capital flow it causes alter another independent variable sufficiently to halt or even reverse the originally expected capital flow.[1] The difficulty in estimating these effects is that they occur simultaneously and therefore cannot be differentiated statistically. This problem will be clearly evident in the estimates which follow.

Policy Variables

From the model the partial effects on short term capital flows of three variables which indicate policy changes may be obtained. The three policy tools are the interest rate, the forward exchange rate, and the spot exchange rate. An estimate of the effect on short-term capital flows of an increase in the Canadian interest rate which results in a one percentage point increase in the interest differential will be estimated first.

The initial impact of the increase in the interest differential is a capital inflow of approximately $570 million. Unfortunately this estimate is inconsistent since ordinary least squares estimators have been applied to a

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[1] Richard E. Caves and Grant I. Reuber, Capital Transfers and Economic Policy: Canada, 1951-1962, Harvard Economic Studies, Vol. CXXXV, (Cambridge, Mass.: Harvard University Press, 1971), p. 127.

structural equation of a simultaneous equation system.[2] The independent variables were assumed to be mainly independent of one another but this is not the case. A rise in the interest differential causes an increased capital inflow part of which is covered in the forward market. This then increases the demand for forward cover and reduces the forward exchange rate. The cost of forward cover increases and tends to reduce the capital inflow. Similarly, the capital inflow puts upward pressure on the exchange rate. A rise in the exchange rate in return slows the capital inflow.

Caves and Reuber attempted to estimate the relationship of the forward rate to the interest differential[3] but the relationship could not be proven to be different from zero. However in the test, ordinary least squares were used on the structural equations of a simultaneous system.

Further the $570 million capital inflow for a one percentage point increase in the interest differential is misleading. To cause the $570 million inflow the interest differential would have to be initially greater than one percentage point then allowed to fall below this level or, the one percentage point difference would have to be

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[2] Jan Kmenta, Elements of Econometrics (New York: Macmillan Company, 1971), p.550.
[3] Caves and Reuber, p.130.

maintained throughout the period. Over the period DS must average one percentage point. If the period is begun with a policy which caused a one percentage point interest differential the capital inflow would increase the supply of funds in Canada and therefore lower the differential so that the full estimated inflow of $570 million would not occur.

The next policy tool effect to be calculated is the forward exchange rate. Assume the forward rate is forced down sufficiently to cause a one percentage point increase in the quarter's CFC. The resulting capital outflow is approximately $263 million per quarter. This capital outflow will reduce the supply of short term funds and therefore increase the Canadian interest rate and the interest rate differential. The capital outflow will also change the exchange rate. Both the change in the interest rate and exchange rate will affect further capital flows. The estimate of $263 million is then only a partial estimate which may be completely altered by other adjustments.

Caves and Reuber estimated the two secondary effects also by the ordinary least squares method. They estimate that the increase in the cost of forward cover will increase the interest differential by .5044 of a percentage point.*

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* Ibid., p.140.

Their estimate of the effect of STK on the exchange rate cannot be concluded to be significantly different from zero.

Realizing the inaccuracy of the estimate the original capital outflow may be altered by adding the inflow due to the increase in the interest differential which is ($570)(.5044) = $287 million. Our net result is an inflow of -263+287 = $24 million. Increasing the cost of forward cover may not have reduced the capital inflow as desired.

The accuracy of the estimate is very doubtful. First, two estimates, both having a fair sized standard error, were multiplied together. Therefore, the possible error has been compounded. Secondly ordinary least squares estimates of structural equations of a simultaneous system have been used. Thirdly, there was a bias in the original estimate of the coefficient of CFC. The lower forward rate increased the cost of forward cover which reduced the capital inflow but, the reduced capital inflow will reduce the demand for forward cover, and therefore encourage an increase in the forward rate. The original estimate of the capital outflow is smaller than it would be if the adjustment in CFC could be maintained.

The third policy tool is adjustment of the spot exchange rate. From the model the initial effect of a rise in the exchange rate of one dollar is a capital outflow of

more than $4,674 million. To best explain how this figure was obtained let us use partial derivatives letting "d" stand for the partial derivative. We wish to obtain dSTK/dRS.

From the model, we have:

$$\frac{dSTK}{dRS} = \frac{dSTK}{dCRS}\frac{dCRS}{dRS} + \frac{dSTK}{d(1-RS)}\frac{d(1-RS)}{dRS}$$

Substituting in from the model, yields:

$$\frac{dSTK}{dRS} = -3168(1) + 1506(-1) = -4674$$

But this is not the complete effect on the short-term capital flow of a one dollar increase in the exchange rate. The variable CFC is also determined by the exchange rate. The change in STK due to the change in CFC must also be included. Assuming for the present that the adjustment in the spot rate is not felt in the forward market:

$$\frac{dSTK}{dRS} = \frac{dSTK}{dCRS}\frac{dCRS}{dRS} + \frac{dSTK}{d(1-RS)}\frac{d(1-RS)}{dRS} + \frac{dSTK}{dCFC}\frac{dCFC}{dRS}$$

where $dCFC/dRS = 100RF/RS^2$

Since RF has a positive value while dSTK/dCFC has a negative value, the capital outflow will be larger than $4674 million, the exact amount depending on the present level of the exchange rates.

As in the previous cases the estimate is very unreliable for policy purposes since a structural equation of a simultaneous system has been estimated as if it were a single equation with exogenous independent variables. The

estimate may be completely incorrect since it is not the end result. The rise in the exchange rate causes a capital outflow which reduces the supply of loanable funds and therefore raises the Canadian interest rate. This will increase the interest rate differential and to some extent reduce or reverse the capital outflow. The forward rate is also closely determined by the spot rate so that the forward rate may also alter further changes in the capital flow. Further, the capital outflow will reduce the exchange rate and therefore lessen the reason for the original capital outflow.

The estimate of the capital outflow, even if the secondary changes are neglected, is only correct if the average of the increase in the exchange rate is one dollar over the period. The increase at the beginning of the period would have to be greater than one dollar to cause this flow.

In summary, estimating a system of simultaneous equations by the ordinary least squares method leads to a great deal of doubt in the estimates. Caves and Reuber have also estimated their model by the two stage least squares method and found that the coefficients are not greatly altered.[5] Therefore we have not undertaken the same steps.

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[5] Ibid., pp. 141-145.

The study has still been of use even though highly reliable estimates of the sensitivity of short-term capital flows to policy variables have not been obtained. We are still able to draw several useful conclusions.

From this study and those of others cited in this paper we can conclude that speculative arbitrage is extensive but that covered interest arbitrage and pure speculation also occur. The existence of covered arbitrage insures us that adjustments in the Canadian interest rate do affect the amount of short-term capital entering Canada.

The studies seem to indicate there are grounds for using the forward rate to affect the capital flow and therefore the interest rate and spot exchange rate. An adjustment in the forward rate changes the cost of forward cover which in turn determines the interest arbitrage capital inflow. Altering the supply of short-term funds then alters the short-term interest rate. Through the flow it affects, the forward rate adjustment will also alter the spot rate. The spot rate will be further altered if the forward rate is taken by speculators as an indicator of future spot rates. The test of this last possibility did not yield greatly significant results as other formulations were found to be better able to simulate the method by which speculators form their expectations of the future rate.

It is also reasonably safe to conclude that speculation was stabilizing in the period tested. If speculators expected the rate to fall they converted their Canadian currency assets into U.S. assets. They in effect ensured the fullfilment of their expectations. The important point though is that speculators did expect the rate to be fairly stable. A rise in the exchange rate did not cause an upward revaluation of the expected rate. Further there is some indication that the "parity psychology" did exist. Speculators may have expected in the long run expect the rate to be near parity, this belief playing some role in the direction they expected the rate to move.

Dividing the short-term capital flow series into its individual components did not improve the explanation of the flow. Within the components, the interest differential, cost of forward cover, and exchange rate expectations were better able to explain the actions of Canadians in the short-term capital market than the actions of Americans. The regressions with American dollar holdings of Canadians in deposit form (ADHCD) as the dependent variable were better explained than were the ones with the Canadian dollar holdings of foreigners (CDHF) and Canadian commercial paper sold abroad (CANPA) as the dependent variables.

The trade credit account, OTHERK, was the best

explained of all the subdivisions of the components but for time series data the degree of explaned variation is very low. It would seem trade credit may be primarily extended to encourage sales.

Possibilities For Further Research

Canada again being under the flexible exchange rate system further opportunity exists to observe the effects of this system. The first step which could be taken is to re-estimate the short-term capital flow model coefficients for the present period and compare the results to the 1950's. Unfortunately at the date of writing insufficient observations are available to allow a reasonable degree of freedom. It would also be of use to undertake a study of the components of the short-term capital flow in which we do not simply apply the aggregate model. Each component should be carefully analysed and a model built specifically for it. The total model may then be formulated allowing for more accurate predictions.

Since the variables of the external sector of the economy are simultaneously determined, it would be useful to develop a model of the sector using a simultaneous equation estimation procedure. The flexible exchange rate system should be allowed for which then requires the inclusion of

an equation explaining the short-term capital flow but not simply as an offsetting flow to the other accounts. This would allow for more accurate estimates of effects of policy decisions on the short-term capital flow.

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